

A PLANET FOR BARNARD'S STAR

Astronomers are "99 percent confident" that this exoplanet for Barnard's star is real and not a false detection. The planet – 2nd closest star system to our Sun – appears to be a cold super-Earth.

Astronomers have discovered thousands of exoplanets in recent years – even an Earth-sized planet orbiting the nearest star to our Sun – Proxima Centauri. Today they announced another exciting finding, a super-Earth planet orbiting the closest single star (and second closest star system) to our own Sun at only six light-years away, Barnard's Star.

The planet has been labelled Barnard's Star b (GJ 699 b). Its discovery has been decades in the making! That mystique, and the nearness of this star to Earth, must have helped encourage an international team of astronomers to work hard to find a planet for Barnard's Star. The team – including astronomers from the European Southern Observatory (ESO), the Carnegie Institution for Science and elsewhere – has published its paper announcing the discovery in the peer-reviewed journal Nature.

Barnard's Star was actually among the first to be announced as having an orbiting planet. In the 1960s astronomer **Peter van de Kamp** argued he saw "wobbles" in the star's motion across our sky, indicating one or more planets tugging on the star. This was proven in error, caused by adjustments in the telescope lens, but the mystique of Barnard's Star endured. Now astronomers found the planet via the same method van de Kamp used – which is called the radial velocity method – aided by instruments with vastly greater power and sensitivity, plus modern computers.

The new planet for Barnard's Star was found by analysing 20 years of combined data from various telescopes, stitched together to create an exceptionally large database. According to lead author **Ignasi Ribas** of Spain's Institute of Space Studies of Catalonia:

We used observations from seven different instruments, spanning 20 years of measurements, making this one of the largest and most extensive Dataset ever used for precise radial velocity studies. The combination of all data led to a total of 771 measurements – a huge amount of information!

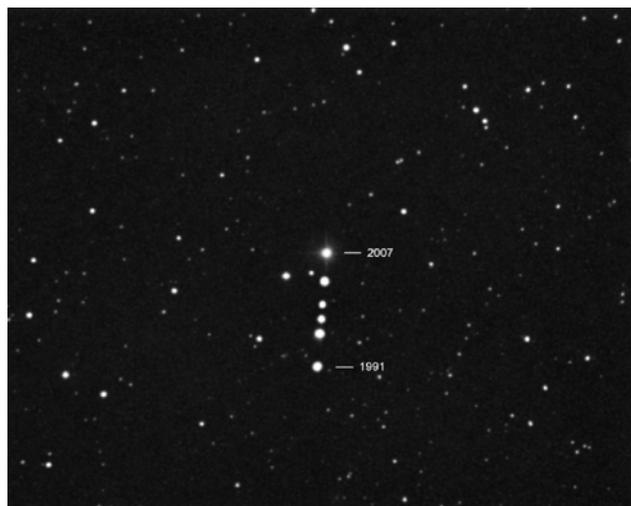
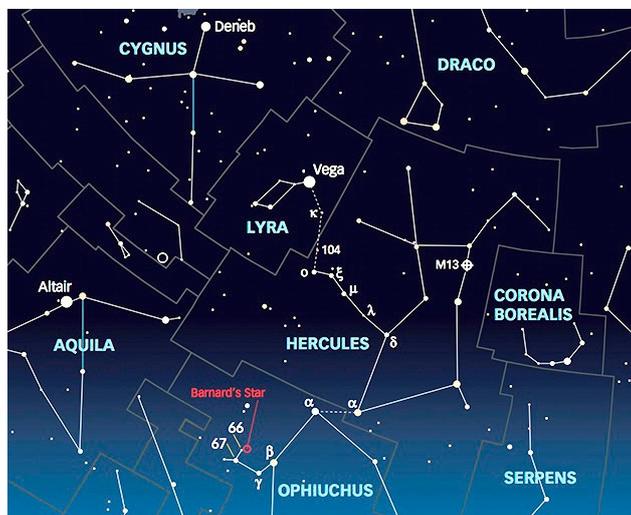
And, indeed, Barnard's Star b is the smallest and most distant planet from its star to be found so far using radial velocity.

The radial velocity technique relies on the fact that a planet's gravity causes tiny wobbles in the orbit of its star. The technique is based on the fact that not only does the star's gravity affect any orbiting planets, but those planets can also affect the star, albeit to a much lesser degree.

According to **Paul Butler** at Carnegie:

This technique has been used to find hundreds of planets. We now have decades of archival data at our disposal. The precision of new measurements continues to improve, opening the doors to new parameters of space, such as super-Earth planets in cool orbits like Barnard's Star b.

Astronomers are very confident that the planet is real.



Barnard's star – the 2nd closest star to Earth – has a large proper motion on our sky's dome. This shows its motion from 1991 to 2007. Now, this very nearby star is known to have a planet.



Our sun's closest neighbors among the stars, including Barnard's Star.

Barnard's Star is a red dwarf star. It's small; here's its size compared to that of our Sun and Jupiter, our solar system's largest planet.

At six light-years away, Barnard's Star is the closest single star to our Sun, but fourth closest star overall, after the three stars that make up the Alpha Centauri triple-star system, which includes Proxima Centauri. It is a red dwarf star, known to produce some flaring, but less active than most other known red dwarfs in terms of stellar flare activity. Like red dwarfs generally, this star is smaller – and believed to be older – than our Sun. Even though it is the second-closest star system, Barnard's Star is too faint to be seen with the human eye.

The star is named for Yerkes Observatory astronomer **E. E. Barnard**, who was the first to notice its large proper motion – or sideways motion on our sky's dome – in 1916.

The large proper motion of Barnard's Star is caused by the star's nearness to Earth, but also by the fact that Barnard's Star – and its newly found planet – are merely passing through our neighbourhood of space, as opposed to moving in the same general stream as our Sun and other nearby stars around the galaxy's centre. Over the long course of astronomical time, Barnard's Star will move farther away!

Barnard's Star b appears to be a super-Earth – a type of exoplanet that is larger than Earth but smaller than Uranus or Neptune. It has a mass 3.2 times that of Earth and orbits its star every 233 days. At that distance, because the star is smaller and cooler than our sun – only emitting 0.4 percent of our sun's radiant energy – the planet is colder than Earth, with an estimated surface temperature of -150 degrees Celsius. This makes it unlikely to be habitable, although little is known still about specific conditions on the planet.

Guillem Anglada-Escudé, from Queen Mary University of London, noted:

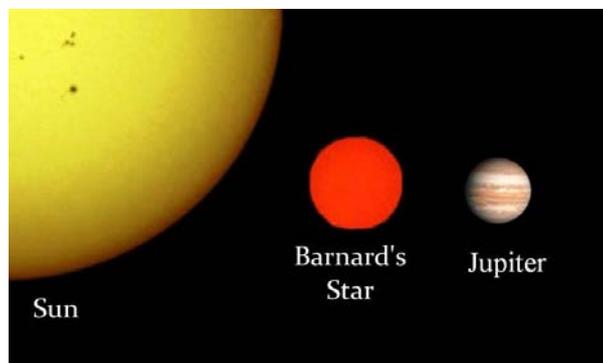
We have all worked very hard on this breakthrough. This discovery is the result of a large collaboration organized in the context of the Red Dots project, which included contributions from teams all over the world.

Follow-up observations are already underway at different observatories worldwide.

These astronomers also note that, since the planet is close, it will be an ideal target for NASA's upcoming Wide Field Infrared Survey Telescope (WFIRST). It might also be possible to observe Barnard's Star via the European Space Agency's Gaia mission, whose second data release earlier this year has yielded a huge bounty of new and exciting insights in astronomy.

Perhaps you know, that over the scale of our human lifespan, the stars appear fixed relative to one another. But Barnard's Star – sometimes called Barnard's Runaway Star – holds a speed record of sorts as the fastest-moving star in Earth's skies. It moves fast with respect to other stars because it's relatively close, only about 6 light-years away. It means Barnard's Star is nearby, and also that it's not moving with the general stream of stars around the Milky Way's centre. Instead, Barnard's Star is merely passing through our neighbourhood of space. Relative to other stars, Barnard's Star moves 10.3 arcseconds per year, or about the width of a full moon in 174 years. This might not seem like much. But – to astronomers – Barnard's Star is virtually zipping across the sky.

The long-standing rumor of planets for Barnard's Star secured this star's place in science fiction. It's featured in, for example, "The Hitchhiker's Guide to the Galaxy" by **Douglas Adams**; "The Garden of Rama" by **Arthur C. Clarke** and **Gentry Lee**; and several novels of **Robert L. Forward**. In these works, the fictional planets of Barnard's Star are locations for early colonization or way-stations for exploration further into the cosmos.



Barnard's Star is named for E.E. Barnard, seen here posing with the 36-inch refractor at Lick Observatory.