Astronomers discover super-Earth around Barnard's star

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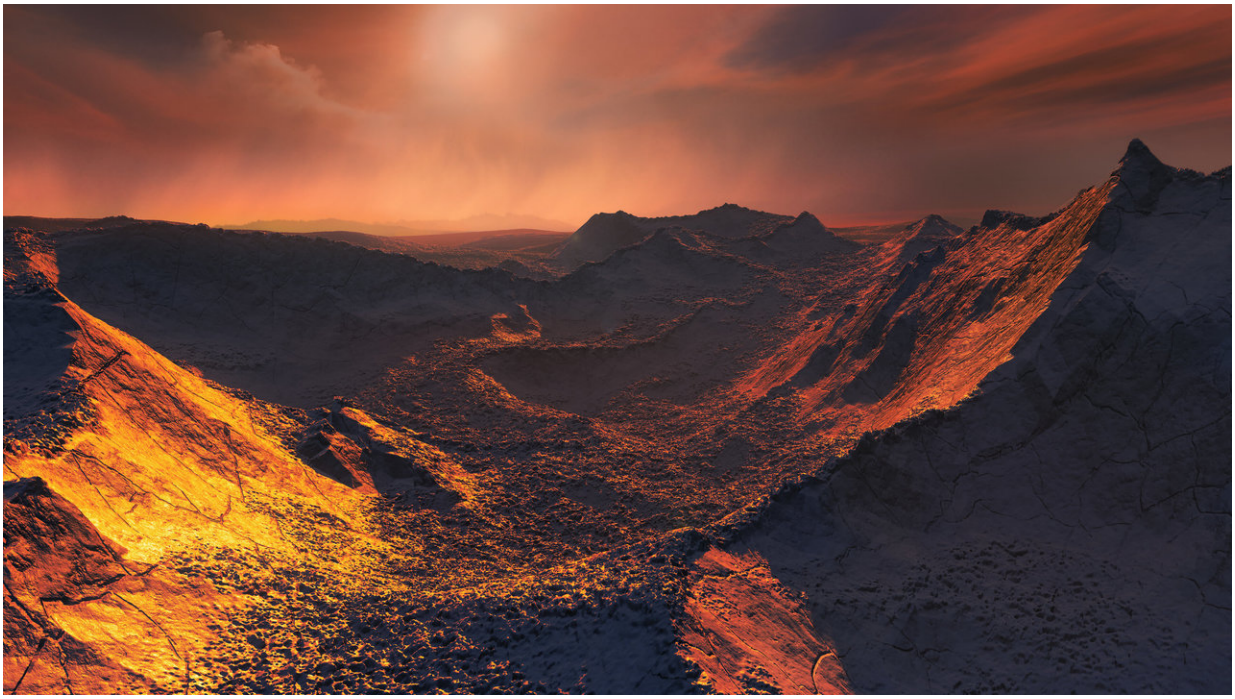


Artist's impression of the surface of Barnard's star b. Credit ESO-M. Kornmesser. Credit: Credit ESO-M. Kornmesser

Astronomers have discovered a planet in orbit around one of the closest stars to the Sun, Barnard's star.

The study was co-led by researchers from Queen Mary University of London, and from the Institut d'Estudis Espacials de Catalunya and the

Institute of Space Sciences/CSIC in Spain.

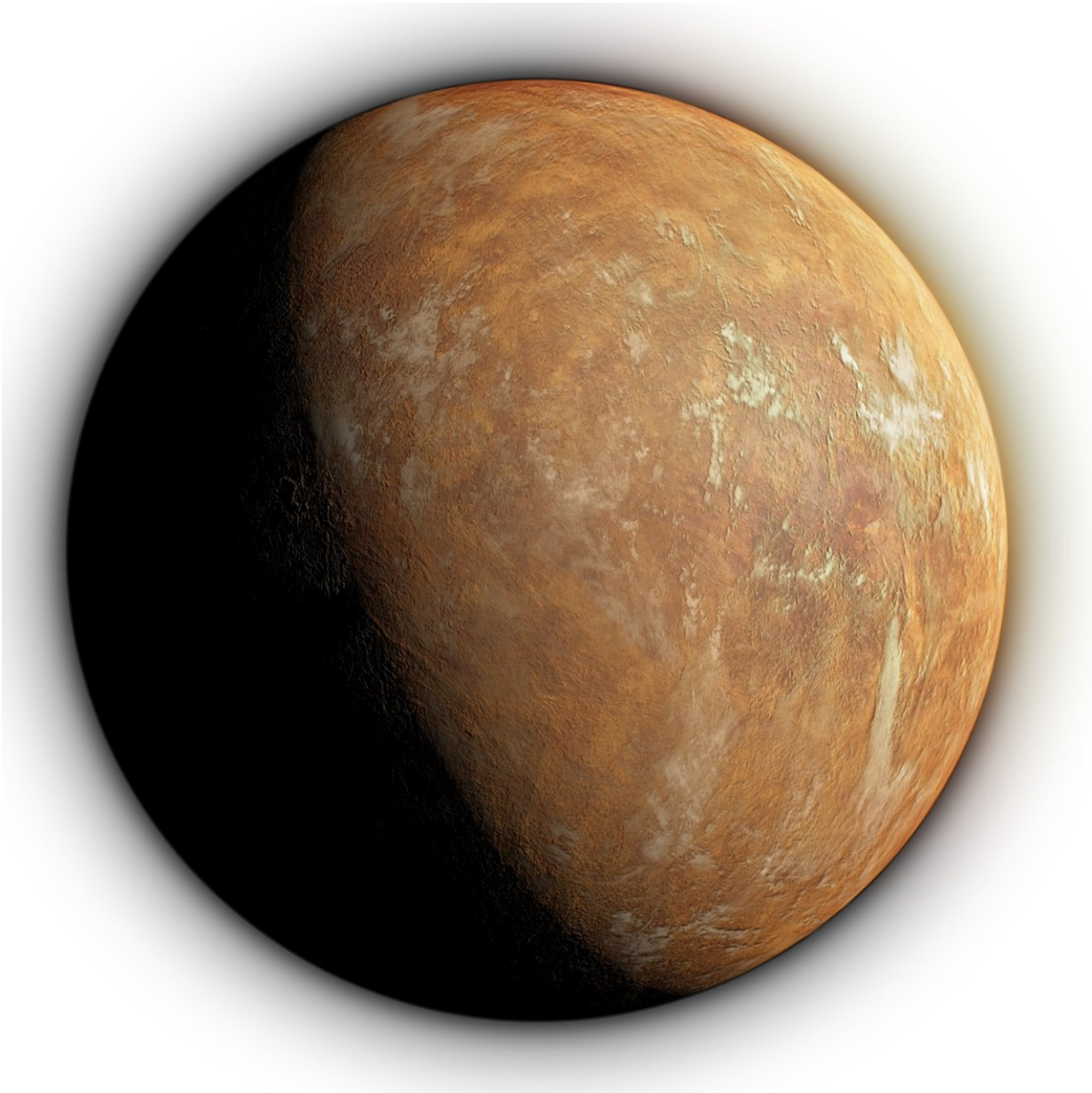
The potentially rocky planet, known as Barnard's star b, is a 'super-Earth' with a mass of at least 3.2 times that of the Earth, and it orbits around its host star once every 233 days.

The results, published in the journal *Nature*, show the planet lies at a distant region from the star known as the 'snow line'. This is well beyond the habitable zone in which liquid water, and possibly life, could exist.

The planet's surface temperature is estimated to be around -170 degrees Celsius meaning it is likely to be a frozen world which is uninviting to Earth-like life.

However, if the planet has a substantial atmosphere the temperature could be higher and conditions potentially more hospitable.

Dr. Guillem Anglada Escudé, from Queen Mary's School of Physics and Astronomy, said: "Barnard's star is an infamous object among astronomers and exoplanet scientists, as it was one of the first stars where planets were initially claimed but later proven to be incorrect. Hopefully we got it right this time."



Artist’s impression of Barnard’s Star planet under the orange tinted light from the star. Credit: IEEC/Science-Wave - Guillem Ramisa

At nearly six light-years away Barnard's star is the next closest star to the Sun after the Alpha Centauri triple system.

It is a type of faint, low-mass star called a red dwarf. Red dwarfs are considered to be the best places to look for exoplanet candidates, which are planets outside our solar system.

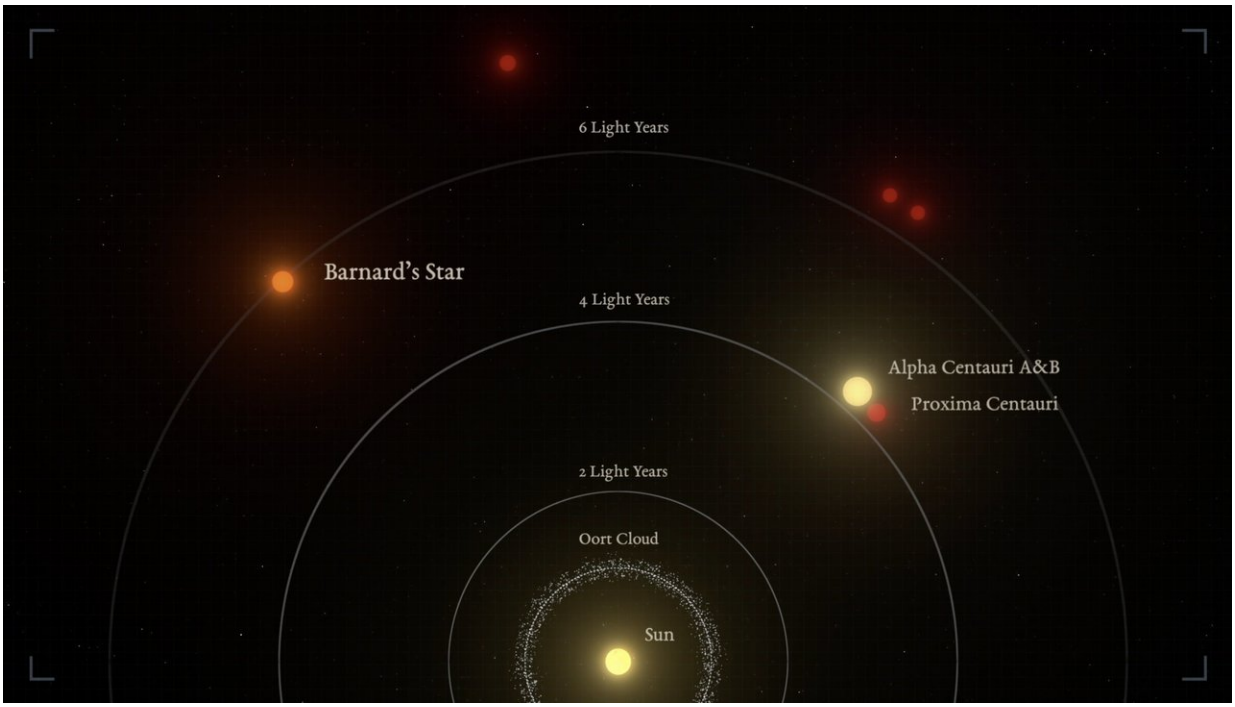
Barnard's star b is the second closest known exoplanet to our Sun. The closest lies just over four light-years from Earth and was also discovered by a team led by Queen Mary's Dr. Anglada Escudé in 2016. That exoplanet, called Proxima b, orbits around the red dwarf star Proxima Centauri.

The researchers used the radial velocity method during the observations that led to the discovery of Barnard's star b. This technique detects wobbles in a star which are likely to be caused by the gravitational pull of an orbiting planet.

These wobbles affect the light coming from the star. As the star moves towards the Earth its spectrum appears slightly shifted towards the blue and, as it moves away, it is shifted towards the red.

This is the first time that this technique has been used to detect a planet this small so far away from its host star.

The researchers re-examined archive data obtained over a 20-year period, and added new observations with the latest generation of instruments, namely the CARMENES spectrometer in Spain, the ESO/HARPS instrument in Chile and the HARPS-N instrument in the Canary Islands.



Graphic representation of the relative distances to the nearest stars from the Sun. Barnard's star is the second closest star system, and the nearest single star to us. Credit: IEEC/Science-Wave - Guillem Ramisa

This wealth of data provided the extraordinary accuracy needed to identify the influence of the planet with near certainty. The wobble observed in the star's motion corresponds to speeds of only just over 1 metre per second—about walking speed.

Dr. Ignasi Ribas, from Institut d'Estudis Espacials de Catalunya and the Institute of Space Sciences in Spain, said: "After a very careful analysis, we are over 99 per cent confident that the planet is there, since this is the model that best fits our observations. However, we must remain cautious and collect more data to nail the case in the future."

Further observations to increase the confidence of this result are already

under way at various observatories, and the system is an excellent candidate for observation by the next generation of instruments specifically designed to image exoplanets directly, such as NASA's planned Wide Field Infra Red Survey Telescope (WFIRST).

If the planet can be observed directly it will provide vital information about its properties and extend our understanding of the kinds of planets that form around red dwarf stars.

An award-winning public engagement campaign, known as Pale Red Dot, allowed the public to follow in real time the observations and analysis that led to the discovery of Proxima b.

The public have also been able to follow the observations leading to this new discovery, a result of extending the search to other very nearby red dwarfs, via a similar web-based campaign known as the Red Dots project, @reddotsspace on Twitter).

The study includes contributions from Professor Richard Nelson and research student John Strachan, both members of Queen Mary's School of Physics and Astronomy.

This research was supported in part by the UK Science and Technology Facilities Council and a Queen Mary University of London Principal's Postgraduate Studentship.

More information: I. Ribas et al. A candidate super-Earth planet orbiting near the snow line of Barnard's star, *Nature* (2018). DOI: 10.1038/s41586-018-0677-y

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