Nearby Tau Ceti may host two planets suited to life

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A star that is a mainstay of science fiction has surged ahead in the race to find life-friendly alien planets. If the discovery of two planets orbiting Tau Ceti is confirmed, they will be the closest potentially habitable exoplanets yet discovered.

Tau Ceti's proximity and similarity to our sun have captured the imagination of writers and made it a promising candidate for life outside our solar system. The star was the target of one of the earliest searches for extraterrestrial life, in 1960, but astronomers had been struggling to see any hints of orbiting planets.

Now Hugh Jones at the University of Hertfordshire, UK, and colleagues have reanalysed observations of Tau Ceti using a new technique that can filter out noise to reveal previously hidden planets. The team discovered five potential planets ranging from two to nearly seven times the mass of Earth, with orbits ranging from 14 to 640 Earth days long.

The highlight of this alien solar system is Tau Ceti e, which has a mass of over four Earths and a year just under half as long as ours. It orbits in the star's habitable zone, the region where liquid water is thought to exist. "It is in the right place to be interesting," says Jones.

Abel Méndez at the University of Puerto Rico at Arecibo has independently analysed the data and says that the fifth planet, Tau Ceti f, may also be in the habitable zone. Jones is cautious, however. "It's not as strong a case, it's only just in the habitable zone," he says.

Wobbly clue

Tau Ceti's five planets were discovered by looking for the small gravitational wobbles they induce in cause the parent star. These wobbles are minute and often obscured by other noise in the data, but Jones's team created a new statistical technique capable of teasing them out. Their work will be published in *Astronomy and Astrophysics*.

Tau Ceti, only 12 light years away, was chosen as a test case because no planets had been found there previously despite the volume of observational data available. Now the technique can be applied to other stars as well. "If these signals hold up as planets, we will likely see their methods used on many more stars," says Philip Muirhead of the California Institute of Technology in Pasadena, who was not involved in the latest work.

The five Tau Ceti planets join a list of over 800 previously discovered candidate exoplanets, including Alpha Centauri B b, which was found earlier this year and is the closest known exoplanet at just 4 light years away. It is too near to its star to be habitable, but could indicate the presence of other, more life-friendly worlds that we have yet to discover. Unlike Tau Ceti and our sun, its host star, Alpha Centauri B, is part of a binary system along with another star, Alpha Centauri A.

Asteroid glut

The Tau Ceti system has its own quirks though, including a large asteroid belt, with 10 times more asteroids and comets than our own solar system. That could harm the chances of life existing, says Jones. "More material around seems like a bad thing in terms of more impacts." Asteroids can also bring water to a planet, however, which could be beneficial.

Xavier Dumusque of the Geneva Observatory in Switzerland, who led the discovery of Alpha Centauri B b, says Tau Ceti e seems promising, but adds that the new technique used by Jones's team has to be independently verified. "If the planet is really there, it would be the best candidate so far to harbour life," he says.

Reference: arxiv.org/abs/1212.4277

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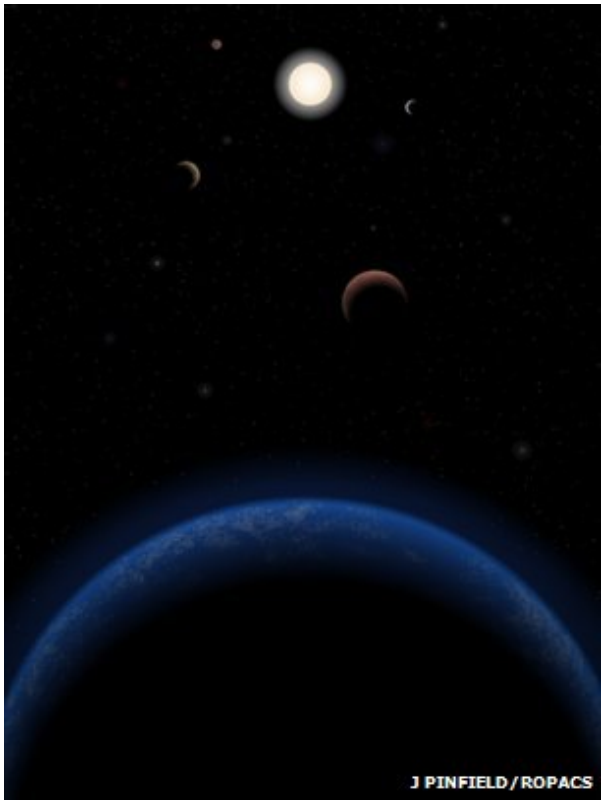
Tau Ceti's planets nearest around single, Sun-like star



An artist's impression shows the five-planet system; from there, our Sun appears in the constellation Bootes

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The nearest single Sun-like star to the Earth hosts five planets - one of which is in the

"habitable zone" where liquid water can exist, astronomers say.

Tau Ceti's planetary quintet - reported in an online paper that will appear in Astronomy and Astrophysics - was found in existing planet-hunting data.

The study's refined methods of sifting through data should help find even more far-flung worlds.

The star now joins Alpha Centauri as a nearby star known to host planets.

In both those cases, the planets were found not by spying them through a telescope but rather by measuring the subtle effects they have on their host stars' light.

In the gravitational dance of a planet around a star, the planet does most of the moving. But the star too is tugged slightly to and fro as the planet orbits, and these subtle movements of the star show up as subtle shifts in the colour of the star's light we see from Earth.

This "radial velocity" measurement is a tricky one; stars' light changes also for a range of other reasons, and requires picking out the specifically planetary component from all this "noise".

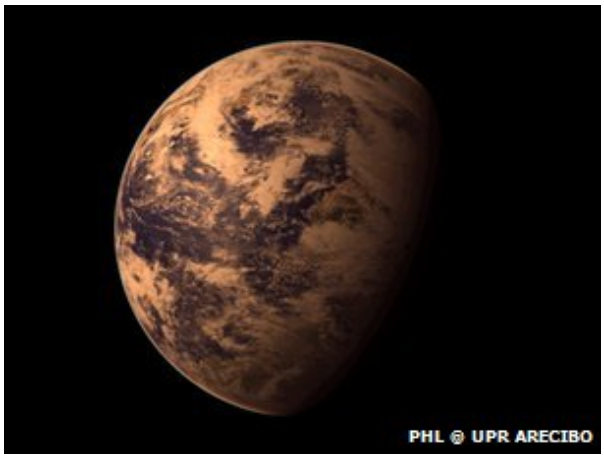
Now, Hugh Jones of the University of Hertfordshire and colleagues have refined their "noise modelling" in order to subtract it, and thereby see the smallest signals hiding in the data - starting with Tau Ceti.

"It's a star on which we have a lot of data - an order of magnitude more data than we have for pretty much any other star," Prof Jones told BBC News.

"It's a good test case for how low can we go, what size of signals can we pick up."

In the noise

The team started with data from three planet-hunting missions: Harps, AAPS, and HiRes, all of which had data on Tau Ceti.



This artists' concept shows one of what is now believed to be six planets around Gliese 667C

The trick to honing the technique was to put in "fake planets" - to add signals into the messy data that planets should add - and find ways to reduce the noise until the fake planets became more and more visible in the data.

"Putting all that together, we optimised a noise-modelling strategy which allows us to recover our fake signals - but in the process of doing that, we actually saw that we were finding signals

as well," Prof Jones said - actual planets.

The quintet includes planets between two and six times the Earth's mass, with periods ranging from 14 to 640 days. One of them, dubbed HD 10700e, lies about half as far from Tau Ceti as the Earth is from the Sun - and because Tau Ceti is slightly smaller and dimmer than our Sun, that puts the planet in the so-called habitable zone.

It is increasingly clear that in existing data from radial velocity measurements there may be evidence of many more planets.

On Monday, Philip Gregory at the University of British Columbia in Canada posted an as-yet unpublished paper to the arXiv repository, claiming to have seen three planets in the habitable zone of Gliese 667C, one of three stars in a triple-star system, 22 light-years away.

It is also clear that in almost every direction we look and in every way that we look, there are planets around stars near and far - the catalogue currently stands at 854 confirmed planets, and is growing with every new publication.