Tau Ceti: Sun-like star only twelve light years away may have a habitable planet

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Artist’s impression of the Tau Ceti system. Credit: J. Pinfield for the RoPACS network at the University of Hertfordshire, 2012

(Phys.org)—An international team of astronomers has discovered that Tau Ceti, one of the closest and most Sun-like stars, may host five planets, including one in the star's habitable zone ('Goldilocks Zone').

At a distance of twelve light years from Earth and visible to the naked eye in the evening sky, Tau Ceti is the closest single star that has the same spectral classification as our Sun. Its five planets are estimated to have masses between two and six times the mass of the Earth, making it the lowest-mass planetary system yet detected. One of the planets lies in the star's habitable zone – the so-called Goldilocks Zone with it's 'just right' temperatures for supporting liquid water – and has a mass around five times that of Earth, making it the smallest planet found to be orbiting in the habitable zone of any Sun-like star.

The international team of astronomers from the United Kingdom, Chile, United States, and Australia, combined more than six-thousand observations from three different instruments and intensively modeled the data. Using new techniques, the team has found a method to detect signals half the size previously thought possible. This greatly improves the sensitivity of searches for small planets and suggests that Tau Ceti is not a lone star but has a planetary system. The team presented its findings in a paper that has been accepted for publication in Astronomy & Astrophysics.

"This discovery is in keeping with our emerging view that virtually every star has planets, and that the galaxy must have many such potentially habitable Earth-sized planets," said coauthor Steve Vogt, a professor of astronomy and astrophysics at UC Santa Cruz. "We are now beginning to understand that nature seems to overwhelmingly prefer systems that have multiple planets with orbits of less than 100 days. This is quite unlike our own solar system, where there is nothing with an orbit inside that of Mercury. So our solar system is, in some sense, a bit of a freak and not the most typical kind of system that Nature cooks up."

Tau Ceti in the early evening sky in constellation of Cetus on Wednesday 19th December from Hatfield, UK. Credit: Stellarium software

First author Mikko Tuomi of the University of Hertfordshire emphasized the importance of new techniques the team developed. "We pioneered new data modeling techniques by adding artificial signals to the data and testing our recovery of the signals with a variety of different approaches," Tuomi said. "This significantly improved our noise modeling techniques and increased our ability to find low-mass planets."

Hugh Jones, also at the University of Hertfordshire, said the researchers chose Tau Ceti for this noise-modeling study because they had thought it contained no signals. "As it is so bright and similar to our Sun, it is an ideal benchmark system to test out our methods for the detection of small planets," Jones said.

Over 800 planets have been discovered orbiting other worlds, but planets in orbit around the nearest Sun-like stars are particularly valuable. "Tau Ceti is one of our nearest cosmic neighbors and so bright that we may be able to study the atmospheres of these planets in the not-too-distant future. Planetary systems found around nearby stars close to our Sun indicate that these systems are common in our Milky Way galaxy," said James Jenkins of Universidad de Chile, a visiting fellow at the University of Hertfordshire.

The researchers discovered this planetary system using data from three state-of-the-art spectrographs: HARPS on the 3.6-meter telescope at the European Southern Observatory in La Silla, Chile (4864 data points); UCLES on the Anglo-Australian Telescope in Siding Spring, Australia (978 data points); and HIRES on the 10-meter Keck telescope on Mauna Kea, Hawaii (567 data points).

The result is based on spectra from taken as part of the Anglo-Australian Planet Search with the UCLES spectrograph on the Anglo-Australian Telescope, HIRES on the Keck Telescope, and reanalysis of spectra taken with the HARPS spectrograph and available through the European Southern Observatory public archive. This work would have not been possible without the ESO public data policies and the excellent work of the ESO Software development division and the ESO Science Archive Facility.

The international research team consists of Mikko Tuomi, Hugh Jones, John Barnes and David Pinfield (University of Hertfordshire); James Jenkins (University of Chile and University of Hertfordshire); Chris Tinney, Rob Wittenmyer, Jonathan Horner, Jeremy Bailey, Duncan Wright and Graeme Salter (University of New South Wales, Australia); Steve Vogt (UC Santa Cruz); Paul Butler (Carnegie Institution for Science); Simon O'Toole (Australian Astronomical Observatory); and Brad Carter (University of Southern Queensland).

More information: The paper (Signals embedded in the radial velocity noise - Periodic variations in the Tau Ceti velocities) is accepted for publication in the journal *Astronomy & Astrophysics* and is available at star-www.herts.ac.uk/~hraj/tauceti

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