UNIVERSITÉ DE GENÈVE

PRESS RELEASE

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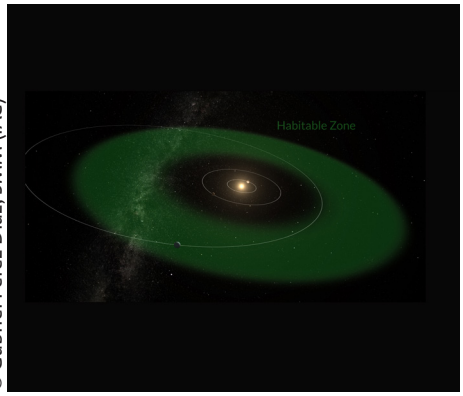
A super-Earth laboratory for searching life elsewhere in the Universe

An international team, including the UNIGE, has discovered a super-Earth that will enable astronomers to test new hypotheses in the search for life in the Universe.

Thirty years after the discovery of the first exoplanet, more than 7000 have been discovered in our Galaxy. But there are still billions more to be discovered! At the same time, exoplanetologists have begun to take an interest in their characteristics, with the aim of finding life elsewhere in the Universe. This is the background to the discovery of super-Earth HD 20794 d by an international team including the University of Geneva (UNIGE) and the NCCR PlanetS. The new planet lies in an eccentric orbit, so that it oscillates in and out of its star's habitable zone. This discovery is the result of 20 years of observations using the best telescopes in the world. The study is published today in the journal *Astronomy & Astrophysics*.

"Are we alone in the Universe?" For thousands of years, this question was confined to philosophy, and it is only very recently that modern science has begun to provide solid hypotheses and evidence to answer it. However, astronomers are making slow progress. Each new discovery, whether theoretical or observational, adds to the edifice by pushing back the limits of knowledge. This was the case with the discovery in 1995 of the first planet orbiting a star other than the Sun, which earned two UNIGE researchers, Michel Mayor and Didier Queloz, the 2019 Physics Nobel Prize.



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This image shows the habitable zone around the star HD 20794 (in green) and the trajectory of the three planets in the system. The orbit of HD 20794 d is eccentric.

High resolution pictures

Video

Nearly thirty years later, astronomers have taken many small steps towards detecting more than 7,000 exoplanets. The current scientific consensus points to the existence of a planetary system for every star in our galaxy. Astronomers are now looking for exoplanets that are easier to characterise or have interesting features to test their hypotheses and consolidate their knowledge. This is the case of planet HD 20794 d, which has just been detected by a team that includes members of the UNIGE Astronomy Department.

In the habitable zone of its star

This promising planet is a super-Earth, a telluric planet larger than the Earth. It is part of a planetary system containing two other planets. It orbits a G-type star, like the Sun, at a distance of just 19.7 light-years, which is, on the scale of the Universe, in the very close neighbourhood of the Earth. This "closeness" makes it easier to study, as its light signals are more visible and stronger. "HD 20794, around which HD 20794 d orbits, is not an ordinary star," explains Xavier Dumusque, Senior Lecturer and researcher in the Department of Astronomy at the UNIGE and co-author of the study. "Its luminosity and proximity make it an ideal candidate for future telescopes whose mission will be to observe the atmospheres of exoplanets directly."

The interest in planet HD 20794 d lies in its position in the habitable zone of its star, the zone that delimits the place where liquid water can exist, one of the conditions necessary for the development of life as we know it. This zone depends on several factors, mainly the stellar properties. For stars such as the Sun or HD 20794, it can extend from 0.7 to 1.5 astronomical units (AU), encompassing not only the orbit of the Earth but also that of Mars in the case of the Sun. The exoplanet HD 20794 d takes 647 days to orbit its star, around forty days less than Mars.

Instead of following a relatively circular orbit, like the Earth or Mars, HD 20794 d follows an elliptical trajectory with large changes in the distance to its star during its revolution. The planet thus oscillates between the inner edge of its star's habitable zone (0.75 AU) and outside of it (2 AU) along its orbit. This configuration is of particular interest to astronomers because it allows them to adjust theoretical models and test their understanding of the notion of a planet's habitability. If there is water on HD 20794 d, it would pass from the state of ice to the liquid state, conducive to the appearance of life, during the planet's revolution around the star.

Many years of observations

Detecting this super-Earth was not easy and the process was iterative. The team analysed more than twenty years of data from state-of-the-art instruments such as ESPRESSO and HARPS. For the latter, the scientists were able to rely on YARARA, a data reduction algorithm recently developed at the UNIGE. For years, planetary signals had been obscured by noise, making it difficult to discern whether planets actually existed. "We analysed the data for years, carefully eliminating sources of contamination," explains Michael Cretignier, a post-doctoral researcher at Oxford University, co-author of the study and developer of YARARA during his PhD at UNIGE.

The discovery of HD 20794 d provides scientists with an interesting laboratory for modelling and testing new hypotheses in their search for life in the Universe. The proximity of this planetary system to its bright star also makes it a prime target for next-generation instruments such as the ANDES spectrograph for ESO's Extremely Large Telescope (ELT). Knowing whether this planet harbours life will still require a number of scientific milestones and a transdisciplinary approach. The conditions for its habitability are already being studied by the new Centre for Life in the Universe (CVU) at the UNIGE's Faculty of Science.

contact

Xavier Dumusque
Senior lecturer and researcher

Department of Astronomy
Faculty of Science
UNIGE
NCCR PlanetS

xavier.dumusque@unige.ch
+41 22 379 24 06

Michaël Cretignier
Post-doctoral researcher

Department of Physics
University of Oxford

michael.cretignier@physics.ox.ac.uk

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UNIVERSITÉ DE GENÈVE
Communication Department
24 rue du Général-Dufour
CH-1211 Geneva 4

Tel. +41 22 379 77 17

media@unige.ch
www.unige.ch