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First Planetary System discovered by the **KOBE** experiment

European researchers led by the The Center for Astrobiology has confirmed the first planetary system by the KOBE project

03.02.2025 – A team of researchers from various European institutions, led by the **The Center for Astrobiology** (**CAB**, **INTA-CSIC)**, has confirmed the first planetary system around one of the 50 stars monitored by the **KOBE** project. This achievement was made possible thanks to observations from the Calar Alto Observatory (Almería). The system consists of two planets, potentially smaller than Neptune, orbiting a star slightly cooler than the Sun. Due to their characteristics, these stars are considered the "El Dorado" in the search for life beyond the Solar System. The discovery demonstrates the potential of the **KOBE** project with results that maximize the available instrumentation.

Press release

The search for habitable planets beyond the Solar System has mainly focused on stars like our Sun. The reason for this, it is that the only known planet that harbors biological activity is Earth itself: a world almost entirely covered in liquid water and orbiting a G-type star, the Sun. More recently, the search has expanded to cooler stars (known as M-type stars). However, both types present difficulties that could be solved by a type of star with intermediate properties, the so-called K-type stars. These seem to provide the ideal environment for the development of life on the surface of planets around them.

Astronomers define the habitable zone as the region around a star where a planet can have liquid water on its surface. This abundant compound on Earth is considered the minimum requirement for the development of life as we know it. For a planet, being in the habitable zone of its star must not be too close to its star (as the water on the surface would evaporate), nor too far away that the water on its surface would freeze. The range of distances in which a planet can be at the perfect temperature for water to be in liquid form depends on the temperature of the star. In stars like the Sun, this region is found in orbital periods of several hundred days, as it is the case with Earth and its 365-day year. Detecting planets at these distances is very complex with current techniques. M-type stars are cooler, so the habitable zone is very close, with periods of a few dozen days, facilitating the detection of planets. However, these cool dwarfs are very active, launching energetic flares that can reach this habitable zone, threatening any type of life that might arise on planets within this region.

On the other hand, K-type stars have the best properties of both types. The periods in which the habitable zone is found are accessible to current instrumentation. Additionally, they are very quiet stars, without major activity events. Therefore, they are considered the "El Dorado" of stellar habitability.

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Searching for planets around them is, thus, a fundamental objective in modern exoplanetary exploration, focused on astrobiological goals.

The **KOBE** experiment is an observation program led by **The Center for Astrobiology** in collaboration with the Institute of Astrophysics and Space Sciences in Portugal, The Marseille Astrophysics Laboratory, and the Geneva Observatory. Its observations are carried out with the **CARMENES** instrument, installed at the Calar Alto Observatory in Almería. The goal of this project is searching for planets in the habitable zone of 50 K-type stars. Since 2021, the **KOBE** team has been monitoring the velocity of these 50 stars with the **CARMENES** spectrograph, carefully selected at the beginning of the project to maximize the chances of success.

In one of these stars, named **KOBE-1**, the team, led in this work by predoctoral researcher **Olga Balsalobre Ruza**, from **The Center for Astrobiology**, has detected the signal of two planets orbiting with periods of 8.5 (**KOBE-1b**) and 29.7 days (**KOBE-1c**). Thanks to the **CARMENES** data, a minimum mass for these planets of 8.8 and 12 times the mass of Earth, respectively, has been established. However, without a measure of their radius, their composition is still unknown. Olga explains that “with these masses, both planets could be classified as super-Earths, that is, rocky bodies slightly larger than Earth, or as sub-Neptunes, characterized by large hydrogen and helium atmospheres that make them lighter than Neptune. We hope to resolve this question with the arrival of new space instrumentation in the coming decades, which will allow direct imaging of both planets”.

Although these new planets are not in the habitable zone, using the same data, the team has been able to rule out planets with masses greater than about 8 times the mass of Earth in this region of great astrobiological interest. This means that if there is any planet in this range of distances to the star, it would be in the rocky regime. More data is still needed to explore this regime in detail.

Finally, Jorge Lillo-Box, researcher at the **CAB**, co-author of the article and principal investigator of the **KOBE** experiment, comments that “programs like **KOBE** are an exception in the scientific field, as they require a lot of observation time over several years to detect these signals” and continues by noting that “**KOBE** has been possible thanks to the commitment of the Calar Alto Observatory to a scientifically innovative but risky project due to the large long-term investment, but which can provide significant advances in our knowledge of the best planetary environments for the emergence and development of life beyond Earth, informing future space missions such as the **European Space Agency**'s **PLATO**”.

About CAB, INTA-CSIC

The *The Center for Astrobiology* (**CAB**) is a joint research center of **INTA** and **CSIC**. Created in 1999, it was the first center in the world specifically dedicated to astrobiological research and the first non-US center associated with the NASA Astrobiology Institute (NAI), currently **NASA Astrobiology Program** (**NAP**). It is a multidisciplinary center whose main objective is to study the origin, presence and influence of life in the Universe. The Center for Astrobiology was distinguished in 2017 by the Ministry of Science and Innovation as a "María de Maeztu" Unit of Excellence.

CAB has led the development of the REMS, TWINS and MEDA instruments, all operational on Mars since August 2012, November 2018 and February 2021, respectively; as well as the science of the **ESA** ExoMars mission's RLS raman instrument. In addition, the center develops the SOLID instrument, aimed at the search for life in planetary exploration. The **CAB** also participates in different missions and instruments of great astrobiological relevance, such as CARMENES, CHEOPS, PLATO, BepiColombo, DART, Hera, the instruments MIRI and NIRSpec in JWST and the HARMONI instrument in the ELT from ESO.

More information

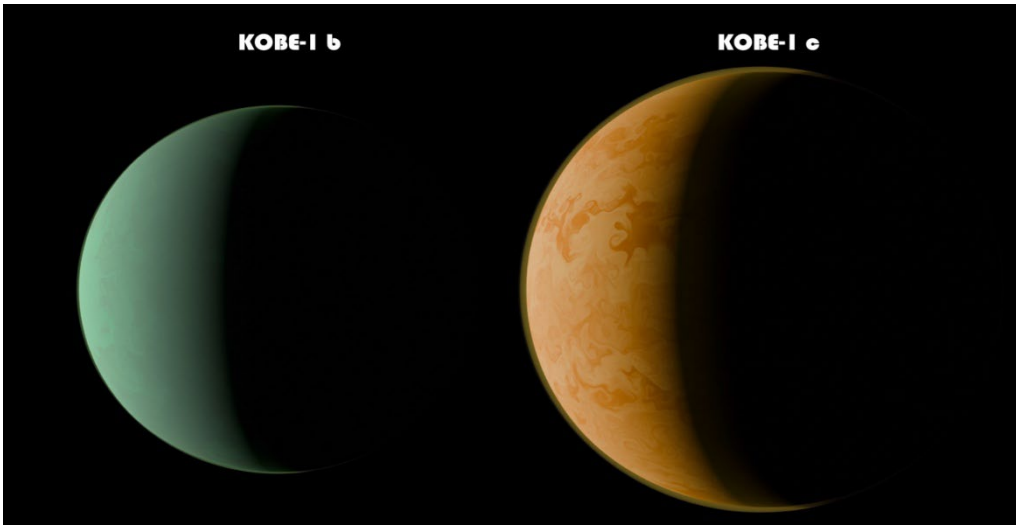

Figure 1. *Artistic illustration of the first two planets discovered by the KOBE project on the star KOBE-1 (HIP 5957). While KOBE-1b is probably coupled with its star (always presenting the same face to its star), KOBE-1c could be a mini-Neptune-type planet.* ***Credit:*** *CAB/Jorge Lillo-Box*

Scientific article available in Astronomy & Astrophysics:

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KOBE-1: The first planetary system from the KOBE survey (Balsalobre-Ruza et al., 2025). DOI: 10.1051/0004-6361/202452631

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