PRESS RELEASE

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Discovery of the first planetary system of the KOBE experiment

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

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The search for habitable planets beyond the Solar System has traditionally focused on stars similar to our Sun. This focus stems from the fact that the Earth is the only known planet hosting life: a water-rich world orbiting a G-type star, the Sun. More recently, attention has expanded to cooler stars, the so-called M-type stars. However, both G- and M-type stars present challenges that could potentially be overcome by stars with intermediate properties: K-type stars. These stars appear to offer an optimal environment for the development of life on the surface of planets orbiting them.

Astronomers define the habitable zone as that region around a star in which a planet can harbor liquid water on its surface. This abundant compound that we have on Earth is considered the minimum requirement for the development of life as we know it. For a planet to be in the habitable zone of its star, it must be neither too close to its star as the water on the surface would evaporate, nor so far away that the water on its surface would freeze. The range of distances at which a planet can be at the perfect temperature for water to be in liquid form then depends on the temperature of the star. In stars like the Sun, this region is found in orbital periods of several hundred days, as is the case of the Earth with its 365-day year. Detecting planets at such distances is very complex with current techniques. M-type stars are cooler, so that the habitable zone is very close, with periods of a few tens of days, facilitating the detection of planets. However, these cool dwarfs are very active, experiencing energetic flares that can reach this habitable zone, threatening any 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. In addition, they are very quiet stars that do not experience major activity events. They are, therefore, considered *El Dorado* of stellar habitability. The

search for planets around them is hence a fundamental objective in modern exoplanetary exploration, focused on astrobiological objectives.

The KOBE experiment is an observational program led by the *Centro de Astrobiología* in collaboration with the *Instituto de astrofísica e Ciências do espaço* of Portugal, the *Laboratoire d'Astrophysique de Marseille* and the *Observatoire de Genève*. Its observations are made with the CARMENES instrument, installed at Calar Alto Observatory in Almería. The objective of this project is to search for planets in the habitable zone of 50 K-type stars. To this end, since 2021 the KOBE team has been monitoring with the CARMENES spectrograph the velocity of these 50 stars, carefully selected at the beginning of the project to maximize the probability of success.

In one of these stars, named KOBE-1, the team, led in this work by the predoctoral researcher Olga Balsalobre-Ruza from the *Centro de Astrobiología*, has found the signal of two orbiting planets with periods of 8.5 (KOBE-1b) and 29.7 days (KOBE-1c). Thanks to the CARMENES data, it has been possible to establish a minimum mass for these planets of 8.8 and 12 times the mass of the Earth, respectively. However, since no radius measurement is available, their composition is still unknown. Olga explains that “with these masses, both planets could be classified either as super-Earths, which are 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 answer 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 are any planets in this range of distances to the star, they would be in the rocky regime. More data are still needed to explore this regime in detail.

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

About CAB, CSIC-INTA

The *Centro de Astrobiología* (CAB) is a joint research center of CSIC and INTA. 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 Astrobiology Center 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 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.

Más información

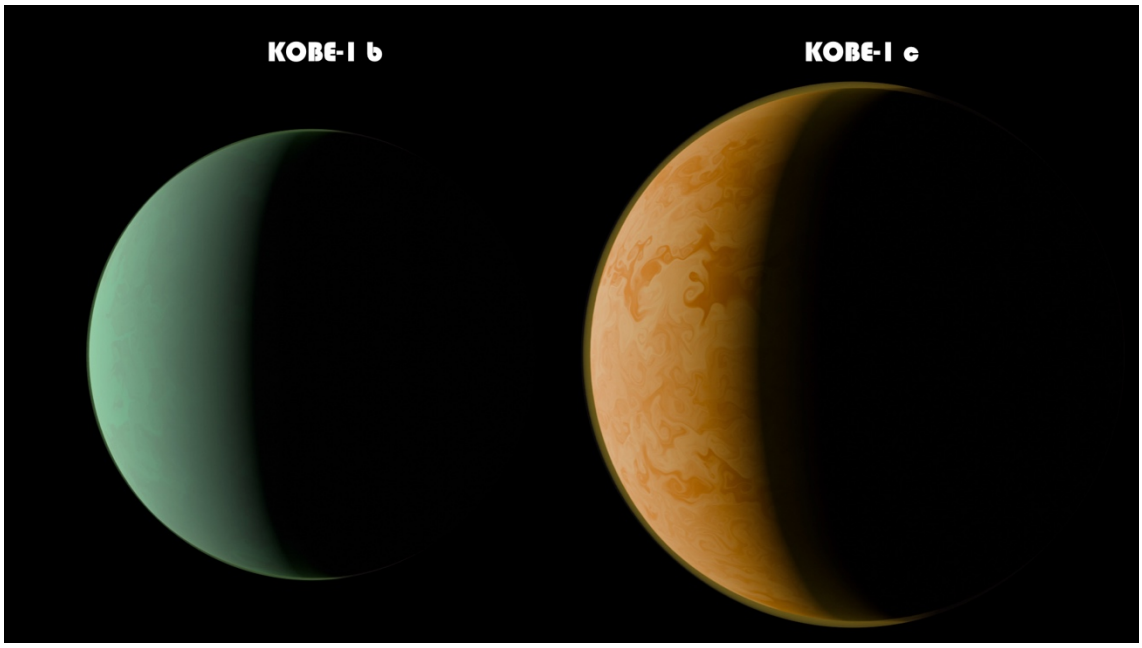

Figure 1. *Artistic illustration of the first two planets discovered by the KOBE project on the star KOBE-1 (HIP 5957). While KOBE-1b is probably coupled with its star (always presenting the same face to its star), KOBE-1c could be a mini-Neptune-type planet.*
Credit: *CAB/Jorge Lillo-Box*

Scientific article available in Astronomy & Astrophysics:

- **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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