These seven alien worlds could help explain how planets form

The Earth-sized astronomical bounty circles a dim star that flew under the radar of exoplanet researchers.

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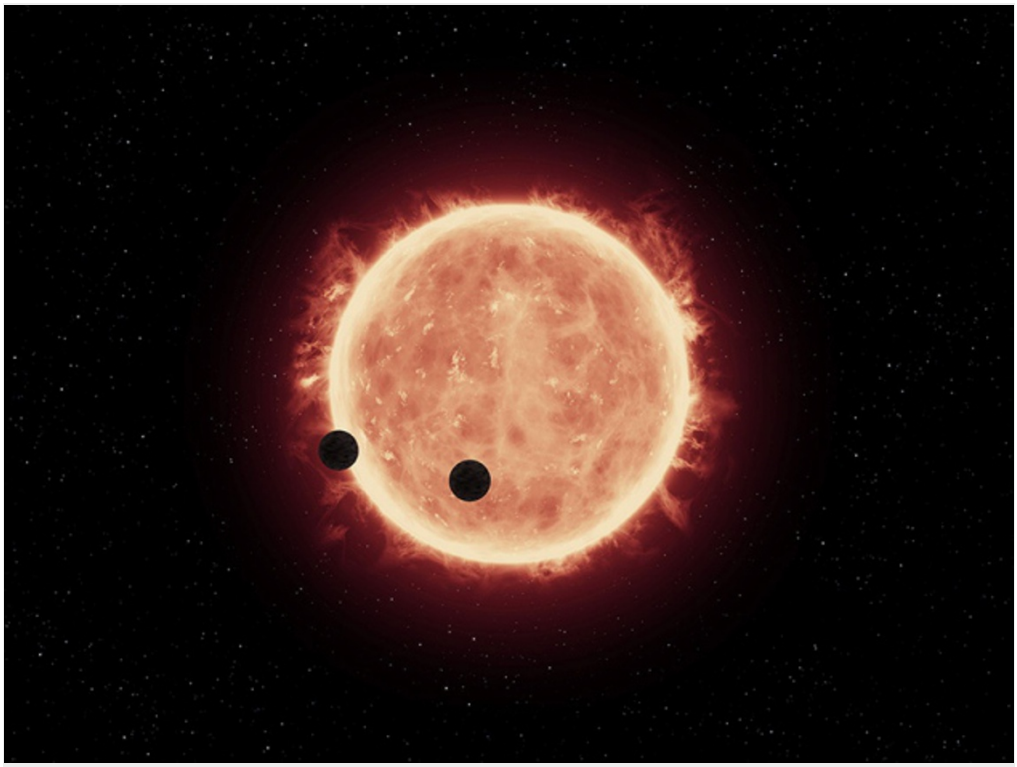


NASA/ESA/STScI/J. de Wit

An artist's illustration shows two Earth-sized planets spinning across the face of an M dwarf star called TRAPPIST-1.

Seven alien, Earth-sized worlds bask in the cool, red light of their parent star. The planetary menagerie exists around a star overlooked by other exoplanet hunters, although it is just 12 parsecs (39 light years) from Earth.

Astronomers have found other seven-planet systems before, but this is the first to have so many Earth-sized worlds. All of them orbit at the right distance to possibly have liquid water somewhere on their surfaces.

“To have this system of seven is really incredible,” says Elisa Quintana, an astrophysicist at NASA’s Goddard Space Flight Center in Greenbelt, Maryland. “You can imagine how many nearby stars might harbour lots and lots of planets.”

Some of the planets were announced last year, but the authors debuted five newfound ones in a paper published on 22 February in *Nature*[1]. Because the system is so close to Earth, astronomers can study the planets' atmospheres relatively easily. That could reveal an astonishing diversity of worlds, ranging in composition from rocky to icy.

"This system is going to be one of the best laboratories we have for understanding the evolution of small planets," says Zachory Berta-Thompson, an astronomer at the University of Colorado Boulder.

It's also vindication for astronomers who hunt for planets around the cool, dim stars known as M dwarfs. These are the most common type of star in the Milky Way, but many exoplanet searches have focused instead on bigger and brighter stars that more closely resemble the Sun. Even NASA's Kepler space telescope, which found most of the more than 4,700 planetary candidates known so far, turned to M dwarfs only recently. "These small stars had been completely overlooked," says Michaël Gillon, an astronomer at the University of Liège in Belgium.

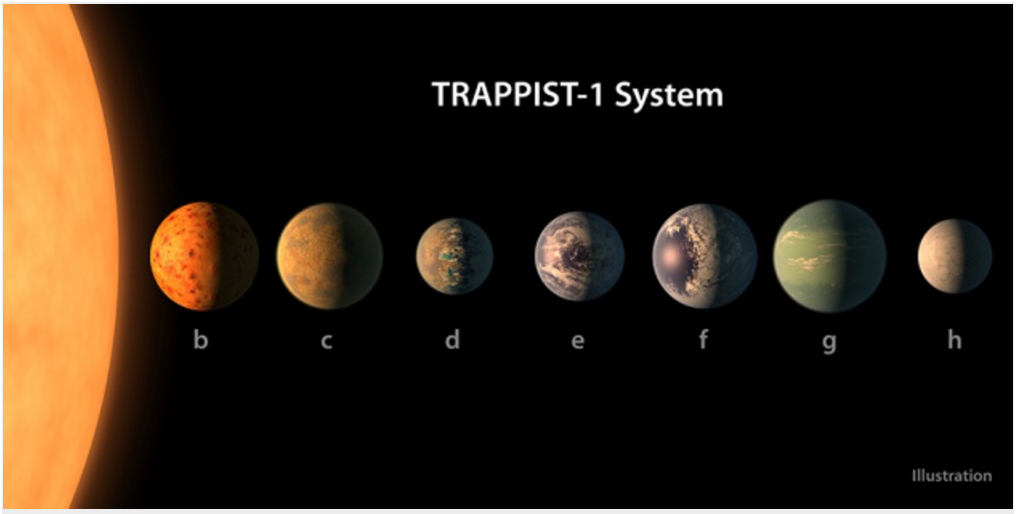
Magnificent seven

Gillon leads the TRAPPIST collaboration, which hunts for planets using two 60-centimetre telescopes: one in Chile and one in Morocco. They look for the faint dimming of a star's light that occurs when a planet moves across its face. The team initially reported three planets around the star, known as TRAPPIST-1, last May[2].

The team had caught only two glimpses of one of those planets, so they followed up on the faint signals with other telescopes. That process included 20 consecutive days when NASA's Spitzer Space Telescope stared at the star. The resulting data revealed that what the scientists thought was a single planet was actually four that orbit their star roughly every 4, 6, 9 and 12 days.

Those four joined the two innermost planets, which whirl around the star once every 1.5 days and 2.4 days. The team also caught a hint of a seventh, more distant planet.

Gillon says that the six inner planets probably formed farther away from their star and then migrated inward. Now, they are so close to each other that their gravitational fields interact, nudging one another in ways that enabled the team to estimate each planet's mass. They range from around 0.4 to 1.4 times the mass of the Earth.



NASA/JPL-Caltech

An artist's illustration of what TRAPPIST-1's seven planets might look like.

Closing in

The arrangement of so many Earth-sized planets so close together will be a bonanza for researchers who are working to compare how worlds evolve. Venus and Earth started out in similar conditions, but ended up in two highly different states; uninhabitable Venus is now choked under a dense blanket of clouds. The TRAPPIST-1 system probably has a similar variety of worlds. "If one of these planets hosts life and the adjacent one doesn't, why not?" asks Sarah Ballard, an astronomer at the Massachusetts Institute of Technology (MIT) in Cambridge.

"This is a Rosetta stone with seven different languages — seven different planets that can provide us with completely different perspectives on planet formation," adds team member Julien de Wit, a data scientist at MIT.

Although at least some fraction of each planet could harbor liquid water, it doesn't necessarily follow that they are habitable. TRAPPIST-1 emits about the same amount of X-ray and ultraviolet radiation as the Sun does, which could chew away at any protective atmospheres the planets might have[3]. And the worlds are likely locked into orbits where the same hemisphere always faces the star, rendering them permanently half-lit and half-dark. That would make it much more challenging for life to thrive.

Other researchers are already using the Hubble Space Telescope to hunt for atmospheres on the TRAPPIST-1 planets. Kepler is also observing the system and will gather data that can better pin down the planetary masses, says Courtney Dressing, an astronomer at the California Institute of Technology in Pasadena. And the TRAPPIST team is building four new 1-metre-diameter telescopes in Chile to continue the work.

“For all the worlds that we see in science fiction, these are even more extraordinary,” says Hannah Wakeford, an exoplanet scientist at Goddard.

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References

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2. Gillon, M. *et al*. *Nature* **533**, 221–224 (2016).

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