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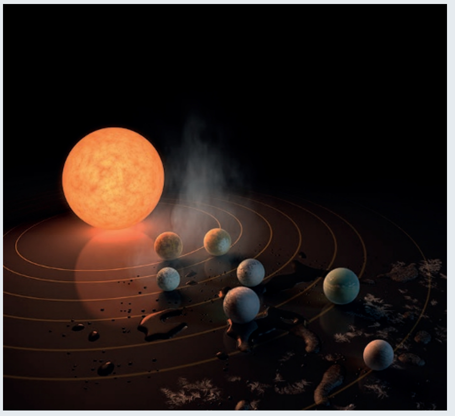
EXOPLANETS

Why should we care about TRAPPIST-1?

The discovery of a system of six (possibly seven) terrestrial planets around the TRAPPIST-1 star, announced in a paper by Michaël Gillon and collaborators (*Nature* **542**, 456–460; 2017) attracted a great deal of attention from researchers as well as the general public. Reactions ranged from the enthusiastic — already hypothesizing a string of inhabited planets — to those who felt that it didn't add anything substantial to our current knowledge of exoplanets and was ultimately not worth the hype. The cover of the *Nature* issue hosting the paper (pictured), made by Robert Hurt, a visualization scientist at Caltech, is a fine piece of artwork, but it also helps us in assessing the actual relevance of the TRAPPIST-1 system.

Firstly, the cover shows a very packed system. This corresponds to reality: all seven planets would fit well within the orbit of Mercury. In fact, the closest analogue of the TRAPPIST-1 system is not our Solar System, but Jupiter and its Galilean moons. TRAPPIST-1 itself is only 1.1 times bigger than Jupiter, and the distance between its innermost and outermost planets, expressed in orbital period, is almost coincident with that between Io and Callisto.

Then, at least six of the planets have radii and masses — and, consequently, densities — close to those of the Earth.



NASA/JPL-CALTECH/ROBERT HURT (IPAC)

They can thus be called 'terrestrial' without any qualms about terminology. In addition, even if the whole system is much less massive than our Solar System, the ratio of the total planetary mass to the mass of the star is comparable ($\gtrsim$1/4,000 for TRAPPIST-1 versus ~1/5,500 for us). This is puzzling as, according to our current models of planetary formation, the total amount of matter in the system should play a role in the efficiency of planetary accretion.

The TRAPPIST-1 planets also form a quasi-resonant chain of orbits (where their orbital periods can be expressed as a ratio of two small numbers), again not dissimilar to what happens in the Jovian system between Io, Europa and Ganymede. This is the first system we've found with terrestrial planets tightly packed together and in resonance.

Their orbits are also all co-planar, as the image shows, and luckily for us this orbital plane passes through the line of sight between us and TRAPPIST-1: all these planets are 'transiting'. This is much more than a simple technical detail, as it allows us to characterize all their atmospheres — an essential step to understand their climate and propensity for habitability.

Finally and maybe most importantly, these planets are distributed over all of the three zones related to different phases of water, as cleverly represented by the illustration. However, this information, linked to the concept of habitable or temperate zone and the possible presence of liquid water on the surface, must be taken with caution, since we do not yet know whether any of the TRAPPIST-1 planets have either an atmosphere or the albedo required for liquid water to survive.

In conclusion, the TRAPPIST-1 system will provide a planetary-scale laboratory to test and constrain all sorts of theories and models concerning planetary formation and evolution, atmospheres, interplanetary interaction and potential for habitability. So yes, we should definitely care about TRAPPIST-1, even if we won't be able to establish a colony there anytime soon.

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