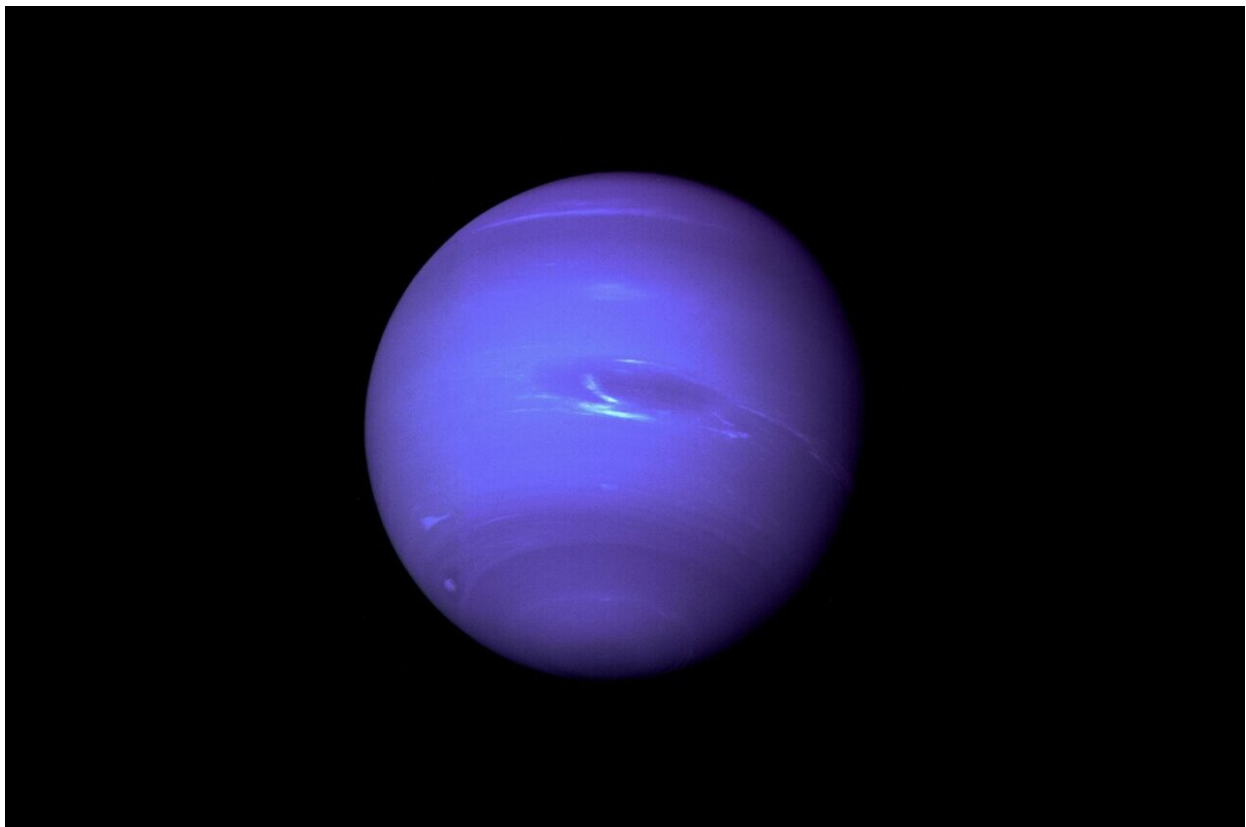


Scientific definition of a planet says it must orbit our sun: A new proposal would change that

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Planetary scientists are proposing a new definition of a planet to replace one that many researchers view as sun-centric and outdated. The current

definition—established in 2006 by the International Astronomical Union (IAU), the organization that officially names objects in space—specifies that to qualify as a planet, a celestial body must orbit the sun within our solar system.

But scientists know that celestial bodies orbiting stars outside our solar system are fairly common, and a forthcoming article in the *Planetary Science Journal* argues for a new definition of a planet that includes being unrestrained by the bounds of our solar system. The proposal also provides quantitative criteria to further clarify the definition of a planet. The paper is currently [available](#) on the *arXiv* preprint server.

Jean-Luc Margot, lead author of the article and UCLA professor of Earth, planetary and space sciences and of physics and astronomy, will present the proposed new definition at the IAU General Assembly in August 2024.

Under the current definition, a planet is a celestial body that orbits the sun, is massive enough that gravity has forced it into a spherical shape, and has cleared away other objects near its orbit around the sun.

"The current definition specifically mentions orbiting our sun. We now know about the existence of thousands of [planets](#), but the IAU definition applies only to the ones in our solar system," Margot said. "We propose a new definition that can be applied to celestial bodies that orbit any star, stellar remnant or brown dwarf."

The authors argue that while the requirement to orbit our sun is too specific, other criteria in the IAU definition are too vague. For example, it says a planet has "cleared its orbit" without stating what that means. The proposed new definition contains quantifiable criteria that can be applied for defining planets inside and outside our solar system.

In the new definition, a planet is a celestial body that:

- orbits one or more stars, [brown dwarfs](#) or stellar remnants and
- is more massive than 10^{23} kg and
- is less massive than 13 Jupiter masses (2.5×10^{28} kg).

Margot and co-authors Brett Gladman of the University of British Columbia and Tony Yang, a student at Chaparral High School in Temecula, California, ran a mathematical algorithm on the properties of objects in our solar system to see which objects clustered together. The analysis revealed groups of distinct qualities shared by planets in our solar system that can be used as a starting point for creating a taxonomy for planets in general.

For example, if an object has enough gravity to clear a path by accumulating or ejecting smaller objects nearby, it is said to be dynamically dominant.

"All the planets in our solar system are dynamically dominant, but other objects—including dwarf planets like Pluto and asteroids—are not," Margot said. "So this property can be included in the definition of planet."

The requirement for dynamical dominance provides a lower limit on mass. But potential planets can also be too big to fit the new definition. Some [gas giants](#), for example, are so large that thermonuclear fusion of deuterium occurs, and the object becomes a substar called a brown dwarf and therefore not a planet. This limit has been determined to be the mass of 13 or more Jupiters.

The current requirement to be spherical, on the other hand, is more problematic. Distant planets can rarely be observed in enough detail to ascertain their shape with certainty. The authors argue that the shape

requirement is so difficult to implement that it is effectively useless for definitional purposes, even though planets are generally round.

"Having definitions anchored to the most easily measurable quantity—mass—removes arguments about whether or not a specific object meets the criterion," Gladman said. "This is a weakness of the current definition."

The good news is that in the solar system, celestial bodies larger than 10^{21} kg appear to be round. So all bodies that satisfy the proposed lower limit on mass of 10^{23} kg are expected to be spherical.

While any official change to the IAU definition of planet is likely a few years away, Margot and his colleagues hope their work starts a conversation that results in an improved [definition](#).

More information: Jean-Luc Margot et al, Quantitative Criteria for Defining Planets, *Planetary Science Journal* (2024). [DOI: 10.3847/PSJ/ad55f3](#). On *arXiv*: arxiv.org/abs/2407.07590

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