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Space

There is a new formula for defining a planet – but Pluto is still out of the club

Jonathan O'Callaghan

A MATHEMATICAL formula to determine whether objects in space should be classed as planets could make it easier to identify bodies around other stars – but it is bad news if you want Pluto to regain its planethood.

In 2006, the International Astronomical Union (IAU) demoted Pluto from planet to dwarf planet status in a controversial decision that left our solar system with eight planets. The IAU cited the fact that Pluto hadn't cleared its orbit of other debris as a critical factor in determining what counts as a planet, a decision that irked many astronomers and the public alike.

Jean-Luc Margot at the University of California, Los Angeles, and his colleagues now propose an easier way to define a planet. They say a planet is any body that orbits a star or the remains of a star, and has a mass larger than 1/200th that of Jupiter but smaller than 13 times the mass of Jupiter.

The lower limit, which is equal to 10^{23} kilograms, corresponds to a midpoint between the mass of current dwarf planets and planets of our solar system, but could be adjusted slightly, says Margot. The upper limit is the point at which deuterium fusion begins, moving into the realm of stars rather than planets.

"The current definition is quite restrictive. We're proposing a simpler, mass-based system"

"The current IAU definition is quite restrictive," says Margot. "We're proposing a simpler, mass-based system."

Margot's new system would leave our solar system with its eight clearly defined planets, Pluto not included, and also applies to all known 5700 exoplanets orbiting other stars. "All of them satisfy this criterion by a large margin," says Margot. "So that's sort of satisfying."

One objection to the IAU's planet definition is that it is difficult to see if a body has cleared its orbit. To address this, Margot and his colleagues investigated whether a planet can "dynamically dominate" its orbit, meaning it has the potential to do so.

The team used a mathematical formula linked to the planet's mass and distance from its star that produced a clear divide between the planets of our solar system and smaller bodies, such as the dwarf planets Pluto, Eris and Ceres. Importantly, there is no need to actually observe objects in a planet's vicinity to make the distinction, says Margot, which is impossible to do for exoplanets with our current technology.

The definition also doesn't require any direct measure of a planet's roundness, known as hydrostatic equilibrium, which is a requirement of the IAU definition. "Objects that are dynamically dominant typically will be round," says Margot, and such objects will always be larger than 10^{23} kilograms (*The Planetary Science Journal*, doi.org/m8zg).

Mike Brown at the California Institute of Technology, who was instrumental in Pluto's demotion with the discovery of Eris in 2003, says the work is a "fun way" to define a planet that will spark more debate.

Margot will present the work at an IAU meeting in Cape Town, South Africa, in August.

Technology

Robot dog uses flamethrower to suppress weeds

A ROBOT sporting a flamethrower could stop weeds growing on farms, potentially offering a replacement for harmful herbicides.

Even highly targeted herbicides can cause environmental problems, affecting local wildlife, and "superweeds" are evolving resistance to the most common weedkillers like glyphosate.

Now, Dezhen Song at Texas A&M University and his colleagues have developed a weed control system that uses a burst of heat from a propane-powered flamethrower controlled by a robotic arm, attached to a Spot robot manufactured by Boston Dynamics.

Rather than incinerate a weed, the robot is designed to identify and heat up the centre of the plant, which can stop it growing for several weeks, says Song. "The weeds don't die – you just suppress their growth so it gives your crop a chance to fight the weed."

DEZHEN SONG ET AL. (2024)

A Spot robot equipped with a flamethrower for tackling weeds

Song and his team first tested the flame nozzle to make sure they could accurately target the weed's centre. Then they deployed the robot in a cotton field planted with weeds native to Texas, like common sunflower (*Helianthus annuus*) and giant ragweed (*Ambrosia trifida*). In five trials, the robot located and torched the weeds, with an average of 95 per cent of the flame focused on the weed (arXiv, doi.org/m879).

One limitation is the battery life of Spot, which can only run for about 40 minutes before it needs charging, says Song, but the researchers are working on using a longer-lasting robot. They are also looking at equipping the robot dog with a device that can deliver more than 10,000 volts, which will stop weed growth for longer, he says.

The robot is more precise than other weed-burning methods and its success will depend on how well it can avoid damaging crops, says Simon Pearson at the University of Lincoln, UK.

Alex Wilkins