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Solar system

Distant, tiny world Quaoar has a ring that seems to defy laws of physics

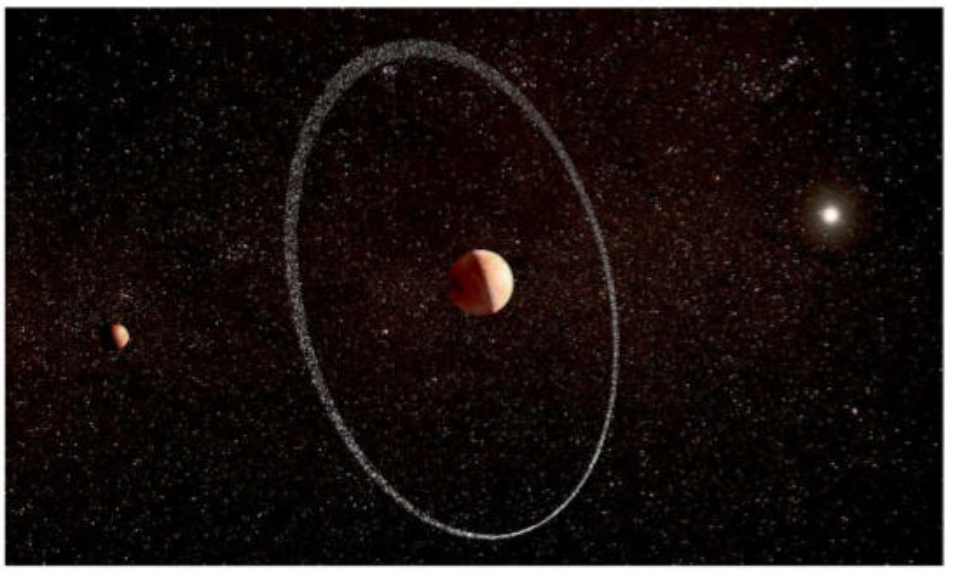
Alex Wilkins

QUAOAR, a dwarf planet that sits beyond Neptune in our solar system, appears to have a ring of debris around it that is way further out than was thought possible.

"We have observed a ring that shouldn't be there," says Bruno Morgado at the Federal University of Rio de Janeiro in Brazil.

Until now, every ring or orbiting moon observed has obeyed a limit put forward by the astronomer Édouard Roche in 1848 that relates to its distance from a parent body. If an object is below the Roche limit, its parent body's gravity rips apart the orbiting object into a collection of smaller chunks that eventually form a ring, like those seen around Saturn. Outside that limit, dust and debris should coalesce to form larger objects, such as moons.

Quaoar, which is 1110 kilometres across and slightly less dense than our moon, should have only moons beyond a distance of 2.4 times its radius, but Morgado and his colleagues measured the ring at 7.2 times Quaoar's radius. "It's very, very far outside this limit," says Morgado.



ESA

Artist's illustration of a ring of debris encircling dwarf planet Quaoar

To spot Quaoar's wayward ring, the team observed the dwarf planet against the backdrop of various stars between 2018 and 2021, using Earth-based telescopes as well as the European Space Agency's CHEOPS exoplanet-hunting space telescope. The researchers were able to use changes in the stars' brightness to calculate the ring's characteristics.

They found that it appears to be mostly made up of water ice, a bit like Saturn's F-ring. One unusual feature is its irregular shape – some sections of the ring are 5 kilometres wide, while others span more than 100 kilometres (*Nature*, doi.org/jv93). If you stood on Quaoar's surface, you should be able to see some of the ring's wider sections, says Morgado.

It isn't clear why Quaoar has a ring so far outside its Roche limit, but researchers think the low temperatures – the dwarf planet is a frosty -220°C – might prevent the ring's contents from coalescing.

It is also possible that interactions between the ring's particles or with Quaoar's moon, Weywot, could be sustaining it. Further observations of Quaoar and more simulations of the system will be needed to find out, says Morgado.

Whatever the answer, we might need to modify the Roche limit, which could have implications for other calculations in astrophysics.

"This concept has been used to analyse, for instance, the formation of our moon," says Morgado. "So, if we have seen something that challenges this limit, we need to rethink and better understand why this ring is where it is."

Carl Murray at Queen Mary University of London is hopeful this won't change things too much, because the Roche limit is only a rough guide.

"The Roche limit has its uses, but, in reality, there's no exact radius," says Murray. "It'll depend on the physical properties of the material that's orbiting and, as they've shown here, there are other characteristics that need to be taken account of as well." ▮

Diseases

Massive tick-killing effort fails to reduce Lyme disease cases

KILLING ticks reduces the number and proportion that carry the main bacterium that causes Lyme disease (*Borrelia burgdorferi*), but doesn't lead to fewer reports of people getting sick, according to the largest study of its kind.

Rates of Lyme disease in the US have increased in the past four decades to at least 30,000 cases reported each year. The rise has spurred research, including on a Lyme disease vaccine close to completing clinical trials, as well as on ways to prevent infection from the ticks that transmit the disease.

Black-legged or deer ticks (*Ixodes scapularis*) can transmit *B. burgdorferi* to humans through bites. The ticks become infected when they feed on the blood of infected animals, such as mice or small birds.

Over four years, Richard Ostfeld at the Cary Institute of Ecosystem Studies in New York and his colleagues tested two different tick control methods both separately and together across 24 neighbourhoods in Dutchess county, New York, with more than 2000 people and 849 pets participating in the trial. They tested an anti-tick fungal spray called Met52, spraying all vegetation on properties and several metres inside surrounding forested areas, as well as boxes that brush small mammals with an anti-tick chemical.

Although the researchers found that both methods reduced the abundance of ticks, and the spray lowered the proportion of ticks infected with the Lyme bacterium, there was no effect on the rate of Lyme disease or other tick-borne disease reported in people, compared with placebo controls. Rates of tick-borne disease reported in pets were lower by around half, however (*Pathogens*, doi.org/jwbg).

"Rates of Lyme disease in the US have increased to at least 30,000 cases reported each year"

The findings add to evidence that such tick-control methods, at least as currently used, don't reliably protect people from disease, says Neeta Connally at Western Connecticut State University. ▮

James Dinneen