

Astrowatch

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Is there a 'ninth planet' after all?

Pluto was considered to be the ninth planet of the solar system, until it was relegated to a "dwarf planet" by the International Astronomical Union (IAU) in 2006. It was judged to be too small among many other trans-Neptunian objects to be considered a real planet. Almost 10 years later, two astronomers have now found indications of the presence of a very distant heavy planet orbiting the Sun. While it is still to be detected, it is already causing a great deal of excitement in the scientific community and beyond.

Pluto was discovered in 1930 by a young American astronomer, Clyde Tombaugh, who tediously looked at innumerable photographic plates to detect an elusive planet moving relative to background stars. With the progressive discovery – since the 1990s – of hundreds of objects orbiting beyond Neptune, Pluto is no longer alone in the outer solar system. It even lost its status of the heaviest trans-Neptunian object with the discovery of Eris in 2003. This forced the IAU to rethink the definition of a planet and led to the exclusion of Pluto from the strict circle of eight planets.

Eris is not the only massive trans-Neptunian object found by Mike Brown, an astronomer of the California Institute of Technology (Caltech), US, and colleagues. There are also Quaoar (2002), Sedna (2003), Haumea (2004) and Makemake (2005), all only slightly smaller than Pluto and Eris. Despite these discoveries, almost nobody during recent years would have thought that there could still be a much bigger real planet in the outskirts of our solar system. But this is what

Caltech/R. Hurt (IPAC)

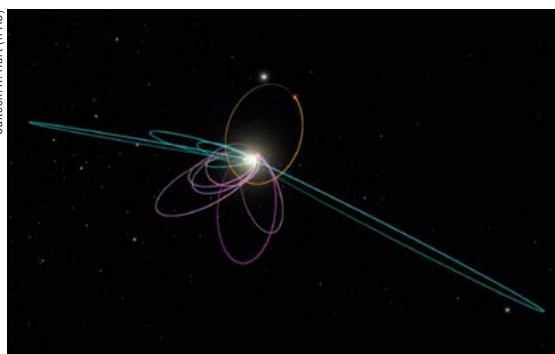


Diagram of the orbit around the Sun of the predicted ninth planet (orange), maintaining the orbits of the six most distant Kuiper-belt objects on the opposite side (pink), and also forcing five known objects into elongated perpendicular orbits (blue). The diagram was created using WorldWide Telescope.

Mike Brown and one of his colleagues, the theorist Konstantin Batygin, now propose.

The two astronomers deduced the existence of a ninth planet through mathematical modelling and computer simulations, but have not yet observed the object directly. The evidence comes from an unexpected clustering of perihelion positions and orbital planes of a group of objects just outside of the orbit of Neptune, in the so-called Kuiper belt. All six objects with the most elongated orbits – with semi-major axes greater than 250 AU – share similar perihelion positions and pole orientations. The combined statistical significance of this clustering is 3.8σ , assuming that Sedna and the five other peculiar planetoids have the same observational bias as other known Kuiper-belt objects.

Batygin and Brown then show that a planet with more than about 10 times the mass of the Earth in a distant eccentric orbit anti-aligned with the six objects would maintain the peculiar configuration of their

orbits. This possible ninth planet would rotate around the Sun about 20 times further out than Neptune, therefore completing one full orbit only approximately once every 10,000 years. Batygin's simulations of the effect of this new planet further predict the existence of a population of small planetoids in orbits perpendicular to the plane of the main planets. When Brown realised that such peculiar objects exist and have indeed already been identified, he became convinced about the existence of Planet Nine.

Observers now know along which orbit they should look for Planet Nine. If it happens to be found, this would be a major discovery: the third planet to be discovered since ancient times after Uranus and Neptune and, as with the latter, it would have been first predicted to exist via calculations.

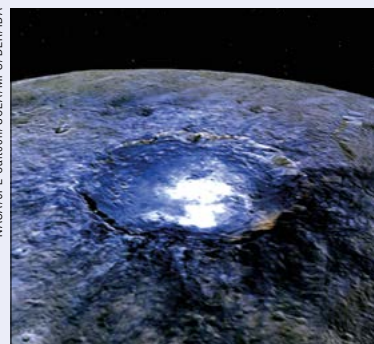
● Further reading

K Batygin and M Brown 2016 *The Astronomical Journal* **151** 22.

Picture of the month

This impressive crater is located on Ceres, the largest object in the asteroid belt between Mars and Jupiter. With a diameter of 950 km, Ceres has been considered, since 2006, a "dwarf planet", as Pluto. And, as this former ninth planet, it has also been visited for the first time by a spacecraft, in 2015. While the New Horizons mission sent back amazing views of Pluto (Picture of the Month, *CERN Courier* September 2015 p17 and November 2015 p17), NASA's Dawn spacecraft was already in orbit around Ceres. Dawn's camera has revealed more than 100 bright spots on the surface of Ceres. The brightest is in the 90 km-wide Occator Crater shown in this false-colour image combining near-infrared and visible observations. The mysterious spots are thought to be a type of salt – a magnesium sulphate called hexahydrate – rather than ice or snow, according to a new study published in *Nature*. An accompanying paper reports ammonia-rich clays, which are usually to be found in the outer solar system. Did Ceres migrate to the asteroid belt from a region near Neptune? Maybe. The solar system is still full of surprises and mysteries.

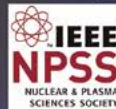
NASA/JPL-Caltech/UCLA/MPS/DLR/IDA



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