

# THE MYSTERIOUS PLANET NINE

*Theoretical evidence is mounting that there might be a huge planet on the fringes of our solar system.*

The hypothetical Planet Nine in front the Milky Way galaxy and lit by the Sun



Astronomers don't usually attract hate mail and rude phone calls. Mike Brown, who has been dubbed as "the man who killed Pluto", is the exception.

The Caltech astronomer led the team that discovered Eris, a rocky world circling the sun far beyond Pluto, in 2003. When it became clear that there were many similar bodies to Pluto and Eris at the outer edges of our solar system, the International Astronomical Union reclassified Pluto as a dwarf planet in 2006. Our solar system was down to eight planets.

According to Brown, planets are characterised as gravitationally dominant objects that dictate the movements of other objects in space. Pluto doesn't fit the bill. At the time of Pluto's demotion, Brown quipped: "Eight, that's it. We now know there are no more planets out there." Yet in 2016, Brown and fellow astronomer Konstantin Batygin argued there was a huge, hidden ninth planet on the fringes of our solar system.

The theory behind Planet Nine first emerged in 2014, when the astronomers Scott Sheppard and Chad Trujillo tried to explain a mysterious clustering of six small trans-Neptunian objects (TNOs) in the Kuiper belt, a field of icy and rocky objects beyond the orbit of Neptune. The orbits of the objects all tilted in the same way, an arrangement that is nearly impossible to generate without the help of some external force.

Sedna, a 1000-kilometre-wide TNO, was particularly interesting. Discovered in 2003 by Brown and Trujillo, Sedna has a bizarre 11,400-year "eccentric" orbit: an elongated ellipse that takes it more than 20 times farther out than Pluto and never brings it closer than twice Neptune's distance from the sun.

It seemed detached from everything, and nothing else seen orbiting the sun shared its strange orbital properties – that >

Below: Planet Nine theorists Mike Brown and Konstantin Batygin study the data in Mike's Caltech office

is, until Sheppard and Trujillo discovered a second detached and eccentric Sedna-like (but much smaller) object, 2012 VP113.

One “Sednoid” was possible; two suggested a pattern. How did they get there? One possibility, suggested by Brown and others, was that the unusual orbits came from a chance encounter with a passing star in our solar system's infancy. Yet a single obscure detail made Sheppard and Trujillo suggest that the cause was a hidden planet: the Sednoids shared an uncanny alignment with several other recently reported “extreme” TNOs. A large planet hiding in the shadows was a plausible explanation for the warped orbits.

This explanation might sound far-fetched, but one way to find planets is by identifying the gravitational tug they exert on other bodies.

That is how Neptune was discovered. After the discovery of Uranus, it was noticed that its motion didn't quite match the predictions of Newtonian gravity. However, the deflection of its orbit could be explained by the pull of an undiscovered planet. In

the mid-1800s John Couch Adams and Urbain Le Verrier calculated the position of such a planet independently. Soon afterward Johanne Galle discovered Neptune based on Le Verrier's predictions.

In 2016, Brown and Batygin released their papers that built on Sheppard and Trujillo's work. Their findings revealed that the six Kuiper belt objects have elliptical orbits that point in the same direction and are tilted about 30 degrees “downward” compared to the plane in which the eight official planets circle the sun. This peculiar clustering is extremely unlikely to happen just by chance. However, the duo's mathematical arguments postulated that a planet in the region of the Kuiper belt could naturally explain it. According to NASA, that planet would have to be substantial, with a mass ten times that of Earth, orbiting the sun every 10,000 to 20,000 years, and circling 20 times farther out than Neptune. The Planet Nine hypothesis had been born.

That same year, another Caltech team attributed a well-known feature of the solar system to Planet Nine. The sun's equatorial plane is aligned six degrees off from the orbital plane of the planets, something that had long puzzled scientists. According to the Caltech team, it is not the sun that is out of alignment but the eight planets; Planet Nine's mass has caused their orbital plane to wobble.

Earlier this year, 2015 BP519 – which could be the size of a dwarf planet – entered the picture. It also has an unusual orbit at a 54-degree angle, which means it isn't on the same plane as the other solar system planets.

To figure how the object achieved this orbit, Juliette Becker, a doctoral student at the University of Michigan, and her colleagues ran simulations of the solar system backward and forward, over millions of years. Nothing seemed to work until they added the hypothetical ninth planet. As they ran the clock, Planet Nine and its gravity swayed 2015 BP519 into its tilted journey around the sun.



**PLANET NINE**

**MASS**  
10X bigger than Earth

**DISTANCE**  
20 billion miles away

**ORBIT**  
10,000-20,000 years

Source: Caltech/R.Hurt (IPAC)

Researchers claim that a huge planet ten times the mass of Earth probably exists in the frozen Kuiper Belt region of our solar system. The planet has not yet been located or photographed. Planet Nine would be about the same size as the most commonly found exoplanets orbiting other stars.



	Earth	Planet Nine	Neptune	Uranus
Mass (Earth=1)	1	10	17	14.5
Average Temperature	59°F (15°C)	-375.8°F (-226°C)	-360.4°F (-218°C)	-357°F (-216°C)

## “The case for the existence of Planet Nine is now genuinely excellent”

KONSTANTIN BATYGIN

“People who want to think that Planet Nine is real will definitely take this as evidence of Planet Nine,” said Becker, the lead author of the paper. “People who are less sympathetic to the Planet Nine hypothesis will probably say that one object never proves anything.”

Brown and Batygin had predicted that over time, Planet Nine’s gravity would push Kuiper belt objects out of their current plane and into ever-higher orbital inclinations. Although astronomers have already spotted a bizarre population of worlds that orbit the sun perpendicularly to the plane of the solar system, they had never caught an object transitioning between the two populations. “There’s no real way to put something on an orbit like that – except that it’s exactly what we predicted from Planet Nine,” Brown said.

“There is no other reasonable way to populate the Kuiper belt with such highly inclined bodies,” Batygin concurred. “I think the case for the existence of Planet Nine is now genuinely excellent.”

However, there are other explanations. A study presented this year at a meeting of the American Astronomical Society looked at new models depicting how the massive swarm of objects that makes up the Kuiper belt orbit the sun.

The team from the University of Colorado at Boulder found that smaller asteroids and icy bits swirl around the sun faster than larger objects, such as Sedna, other minor planets and large asteroids. These small objects tend to bunch up on one side of the sun with their collective gravity tugging on the larger, slower objects.

The researchers calculated the mass of hundreds of trans-Neptunian objects and discovered that it would be possible for similar bodies to create enough gravitational pull to steer objects as large as dwarf planets into extreme orbits. If the theory is correct, it would mean that there is no Planet Nine, but that there are potentially thousands of smaller, undetected objects cruising around the edge of our solar system.

“These orbits crash into the bigger body, and what happens is those interactions will change its orbit from an oval shape to a more circular shape,” explained Jacob Fleisig, an undergraduate at CU Boulder and lead author of the study.

Brown and Batygin are not convinced, with the former claiming there is a 99.9 per cent chance that Planet Nine exists. What we need to do, says Brown, “is find the thing”.

The problem is that nobody is sure where exactly to look for Planet Nine, making it the celestial equivalent of finding a needle in a haystack. However, in a study led by Northern Arizona University and the Lowell Observatory, a team of researchers hypothesize that the Large Synoptic Survey Telescope (LSST) – a next-generation telescope that will go online in 2022 – has a good chance of finding this mysterious planet.

If it exists, that is. ♪

Source: Caltech/  
space.com